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THE IMPLEMENTATION OF MICROCOMPUTER SYSTEMS FOR THE REPUBLIC OF KOREA'S NAVAL SHIPS

By

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The Implementation of Microcomputer Systems for the Republic of Korea's Naval Ships

by

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ABSTRACT

This thesis outlines an approach for the acquisition of microcomputer systems to support the Republic of KOREA's Naval combatant ships. At present, most shipboard information handling operations are performed manually by crew members. These operations are labor intensive, drawing on the Republic of Korea Navy's manpower and operational readiness. To reduce this manpower drain, the development of a microcomputer system onboard ROKN ships is presented. Additionally, system design considerations, and how to choose microcomputer systems onboard ROKN ships are discussed at length.

TABLE OF CONTENTS

LIST OF FIGURES

I. INTRODUCTION

The microcomputer system is an important portion of computer-based ship's management. Recently, the ROKN has felt the impact of the ever changing world of management technology. They saw nationally developed computer industries and firms which have begun using computers and computer systems to support their management.

As a result of these high-tech innovations, the ROKN became concerned about computer systems in late 1970's. However, it was not using effective management styles, since these systems applied only to shore bases and Navy headquarters levels. Most of the ROKN's data originates from ship's routine jobs, with all of them being performed by the crews under traditional management.

This thesis will make the recommendations for establishment of a micro computer - based management system onboard ROKN ships.

What type of microcomputer system is most attractive and how how to apply it onboard ship and what kinds of benefits can be provided to ROKN fleet units will be discussed.

The U.S. Navy's SNAP (Shipboard non tactical ADP program) system will be discussed in hope that the ROKN fleet hierarchy will evaluate this new technological system in light of its relative worth to shipboard management.

II. BACKGROUND

A. HISTORICAL OVERVIEW

The Republic of Korea Navy (ROKN) has a 40 year history. Relative to other free world navies, this is not old in terms of a sea-going service of combatant vessels and service force ships.

The vessels are of an average age of 40 years, and the ROKN headquarters has initiated programs of naval forces modernization. The first program is the modernization of the older combatant vessels:

- installation of new weapon systems (missile system, etc.)
- installation of new communication systems.
- installation of new propulsion systems.

These efforts are supported by the ROKN logistic Supply Center (LSC), naval ship-yard and various civilian industrial activities.

The second program in the modernization effort is the development of new combatant vessels similar in size and mission to the US Navy Destroyer. Recently the ROKN has completed several of these destroyer type vessels. [Ref. 1] These ships are built for the ROKN by Korean civilian ship-building companies. These companies have accumulated expertise through the construction of vessels over the last

five years for export to other free world nations. Based on this experience the newly developed ROK destroyer is a platform for anti-ship, anti-air and anti-submarine operations. The ROK destroyer has been assembled with equipment from several countries. The ROKN, however, should have a planned logistic supply schedule for the maintenance of these vessels in order to plan maintenance actions and responsibility. These schedules are being developed on a continuing basis as more ships are being built. Although this maintenance support program is new to the fleet, it is proving most effective.

ROKN fleet personnel live and work in a changing environment with increasing operating tempo and decreasing manpower inventories. This, combined with new sophisticated equipment (ie. missile systems), which demand professional skill related effort, is placing increased training and maintenance burdens on all levels of command. At this time individual fleet personnel must perform routine jobs, administrative support functions which are labor intensive and frequently require few of the technical skills for which they have been trained. To ROKN fleet personnel, there appears to be no end to the increased administrative burdens that they must bear or to the requests for data from shore-base support commands. In an effort to better support the operating forces the ROKN in operating two computer

mainframe IBM system (360) centers with ten distributed teleprocessing terminals.

The ROKN needs computerized systems in the fleet (shipboard) to automate combatant vessels for increased manpower and better exploitation of valuable manpower and equipment. These systems would allow fleet personnel the following advantages:

- spend less time on paperwork. (internal)
- decision making capability will be improved (internal)
- able to transfer data from shipboard to computer centers or shorebase terminals.

The fleet unit level is the lowest administrative organization in the ROKN. If this system is fully implemented and proves successful, it should be developed further by fleet headquarters to include shore based commands. As result of these, the new systems will provide:

- supporting tactical operations.
- better communications with afloat units.
- facilitate measurement of ship's performance.
- better scheduling of ship's activities.

It has been found that many ROKN fleet units do not want to install the computerized systems onboard ship, even if it will provide better support for the ship's personnel functions.

B. SYSTEM OVERVIEW

Generally, the ROKN ships conform to a standard pattern of shipboard organization. This enables the crew to move from ship to ship with a minimum of time required to adapt to each new organization environment.

The ROKN destroyer's organization is very similar to the U.S. Navy. (Figure 2.1) ROKN regulations require a ship to have at least five departments. These are navigation, operations, weapons (deck), engineering and supply. The ships's general administrative functions are as follows [Ref. 2];

1. General Administration

   a. Basic clerical:

      - process incoming correspondence.

      - publish the Plan-of-the-Day for the coordination and regulation of ship's activities and information of the crew.

      - maintain all ship's correspondence, files, records and reports.

   b. Training:

      - maintain the recording of ship's training requirements and onboard personnel qualifications and skills.

      - plan the long-range and short-range schedules.

2. Personnel Management:

   - assign to duties within the ship's organization all those personnel.

   - maintain the service records of personnel.

- evaluate the performance of officer and enlisted personnel through fitness reports and evaluation sheets.

- leave administration.

- billet and skill inventory management.

- training requirement maintenance.

3. Supply and Financial Management:

- maintains record for the issues, demand periodic reorder of material, setting of reorder levels, and adjustment of inventory by receipt or inventory.

- maintain internal budgeting and consumption files.

- planning and preparation for food service.

- operate pay-roll system (personnel, travel, etc.).

4. Maintenance Management:

- Operate ROKN 3-M system (maintenance and material management) to maintain all shipboard systems at maximum degree of combat readiness.

5. Systems Administration:

- maintain shipboard documents and manuals.

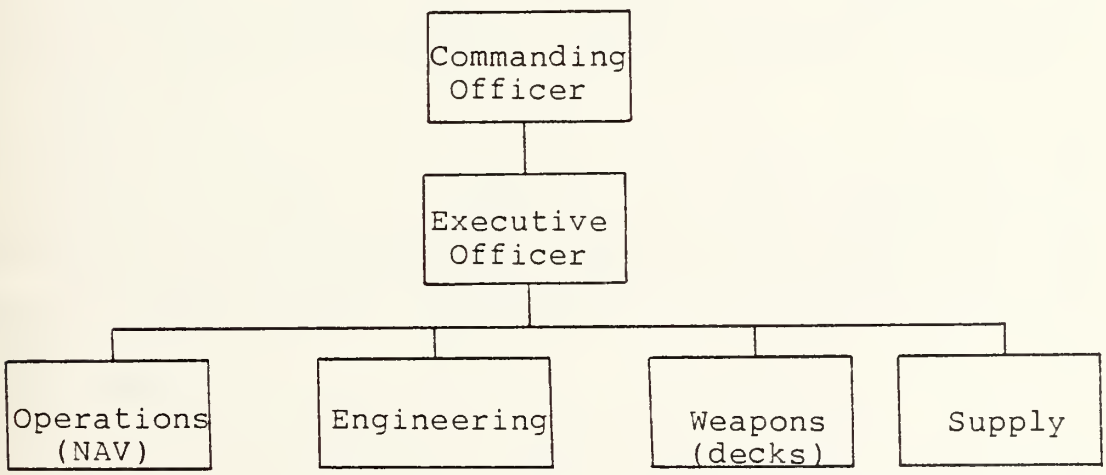


Figure 2.1 Destroyer Class Ship's Organization

C. PROBLEM DEFINITION

The shipboard administration function involves manual procedures that, in the shipboard environment, waste manpower, increase likelihood of error, and reduce the operational efficiency of the ship. Many such restrictive administrative matters are generated on the ship. Besides the obvious physical problems of equipment age and outmoded design and the installation of new modernized equipment, there exists the "nightmare" of maintaining a multitude of weapons and engineering system equipment.

Standardization is almost non-existent. Due to the composition of international sources or old and new technological equipment. The associated paperwork alone is enormous in just keeping track of changes.

The ROKN is currently operating under a critical shortage of trained technicians, because the Navy increased the number of new ships without training programs. The added burden of training personnel to maintain many different versions of similar types of equipment is becoming more difficult.

The fleet training center and navy shipyard have technical training courses for modernization equipment maintenance. These course instructors are contracted and paid by the ROKN.

To solve these problems, ROKN has considered ways to reduce paperwork and maintain accurate data for ship's internal reporting.

The following are labor intensive work departments of the ship [Ref. 2].

1. Operation department

   The majority of the reports and messages are done manually. For example: casualty reports (casrepts), ship's movement reports.

2. Engineering Department

   Scheduling of the current ship's maintenance plan (CSMP), planned maintenance system (PMS) and keeping various record logs.

3. Weapons Department

   Maintain ammunition inventory that includes the size, type and lot number of the ammunition.

4. Supply Department

   Inventory control ship's spare parts, operational targeting financial status (OPTAR) should be able to be balanced at anytime. (i.e., ship's budget report.) Preparing payroll is another large job in this department.

5. Ship's Administration

   Preparing of ship's diary (a daily report showing unauthorized absences, deletions from, and additions to the crew), the Plan-of-the-Day, leave authorization papers, personnel records are required labor intensive works.

D. APPLICATION OF ADP SYSTEMS TO SHIPBOARD ORGANIZATION

1. Computer Use

Computers could be used to quickly supply the information needed to facilitate operations of the

organization, including data for decision making and to satisfy ROKN fleet unit requirements. Modern managers need considerable data to help them make effective decisions. Matching faster improvements in technology events affecting organizations occur with increasing rapidity, and many managerial decisions must incorporate or respond to these events. Under such conditions, the gathering, processing, and distributing of information must be done daily to be effective.

The second reason for computerization is to reduce office costs. This means, the speed and versatility of the computer will reduce 50% of paper work costs.

There is another minor reason, which is reduction of errors. The computer tends to integrate data processing, thus minimizing the handling of data by human beings. [Ref. 3]

The first and most important mission of vessel commanders of the ROKN fleet units is combat readiness. To realize this goal, they must consider using manpower effectively and manage operations economically to fully exploit a limited Navy budget. This similarity to civilian management goals suggests, applying automated systems to the ROKN fleet.

Today computers are classified, by size, model and cost from large-scale to microcomputer. This thesis focuses on microcomputers, because recently developed chip

microcomputers with hard disk mass storage systems and a 16-bit microprocessor are sufficient for the general administration of destroyer class ships.

2. Shipboard Non-Tactical Data Processing System in U.S. Navy

In mid-1960's, the computer based shipboard information system was developed for the U.S. Navy. This system (AN/UYX-5 Computer) was designed to support shipboard 3M (Maintenance and Material Management), SUAOPS (Shipboard Uniform Automatic Data Processing System), and the accounting/ financial functional areas. Later, this system developed into a modernized computer system, which has been called the SNAP-I (Shipboard Non-Tactical ADP program I) system. Generally, the SNAP-I system has been installed on a number of larger ships (e.g. air-craft carrier, repair ships, tenders, etc.) and shore facilities. [Ref. 4]

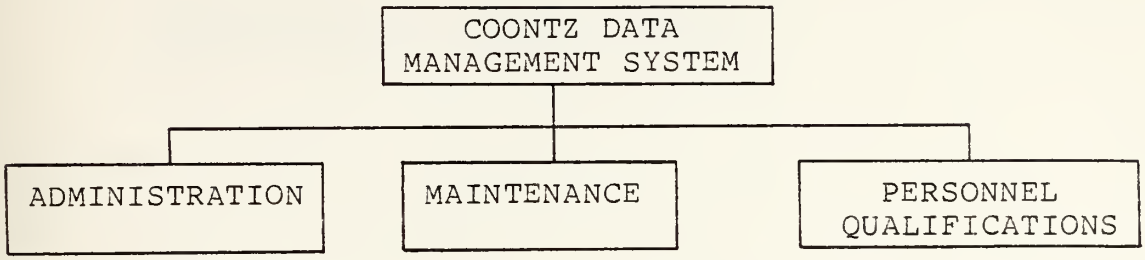
The advent of microcomputers accelerated the development of small ship's automated systems. The U.S. Navy has developed SNAP-I systems for destroyer class, and in 1980, the U.S. Navy installed microcomputer systems on USS Coontz (DDG-40) and USS Arthur W. Radford (DD-968) for testing. Since these microcomputers have the potential for manipulating nontactical data and processing text aboard Navy ships, it is important to determine how these SNAP applications affected shipboard administration and

operations and to identify problems identified for future shipboard computer installations.

Both ships were provided with a data management system (DMS) and word processing system (Figure 2.2), which were commercially developed by Applied Micro Systems. Ltd. The DMS automatically provided for the creation, data entry, updating, and report generation of user-defined data files and databases. The system also provided detail documentation of file layouts and interrelationships between files. The DMS was totally conversational, which meant that the user could respond to questions asked by the system on the video display terminal. Each data file, report, or updating or input routine, when established, was automatically added to a series of customized menus displayed at the user's request.

The word processing system (WPS) was used extensively aboard both ships to prepare text documents, such as memoranda , letters, ship's instructions and notices, ship's bills, standard operating procedures, lesson plans, and naval messages, Larger and more static documents, such as ship's instruction, were stored off-line on spare disk packs that were placed on-line for retrieval, review and updating. These updated instructions were then easily retyped and redistributed using the system printer and the ship's copier machine. The WPS even had the capability to

select which pages to retype to facilitate making small changes to large documents.



- General
- Job/duty/watch-assignment
- Planning/Training
- School
- Physical security
- Medical
- Enlisted Dining Facility

- Zone inspection
- Equipment discrepancy/ corrective maintenance
- Supply

- PQS

Figure 2.2 Coontz Data Management System Structure

Up to now, the overall benefit of the DMS/WPS has been to facilitate the accessibility of information for better planning and decision making, increase the quality of the ship's administrative functions by reducing errors and improving clarity, reduce the manual administrative workload and provide shipboard managers greater opportunities and more time to manage. [Ref. 5]

Recently the U.S. Navy began a development program for small ships non-tactical microcomputer systems for DDG 37 class ships (MICRO-KING) which have a total acquisition

cost under $10,000. It is scheduled for installation on 40 U. S. Navy ships. [Ref. 6]

3. Applications of Non-Tactical Data Processing System for ROKN Fleet Combatant Ships

Since 1975, many changes have occurred in the computer industry. Changing the 'user's view' of the microcomputers; perceptions of what a computer can do are expanding, new units will be marketed with increased capabilities, and prices will be rapidily reduced. The physical size of components will be smaller and smaller for the same computing power.

Recent, fleet-level ships of the ROKN were required to have automated data processing systems installed. The intentions in requiring this system were a resultant saving in manpower and economy in operational costs. When ROKN fleet units are able to install modern equipment, effectively more seapower should be achieved as a result.

Up to now, many of the reports that originated from ROKN fleet units are formatted, and take too much labor to prepare and transmit. Moreover, they are not accurate. The lack of technically capable personnel, coupled with neglect of shipboard equipment and material history records, has reduced combat readiness.

We have described the benefits of the shipboard non-tactical ADP program to U.S. Navy ships. This test improved performance and saved manpower.

The application ADP system to ROKN fleet units should be simplified by the fact that ROKN fleet ships, in organization, regulation and ship's administration are operated in a very similar manner to U.S. Navy destroyers. But compared to the U.S. Navy, ROKN fleet unit has fewer and smaller ships. These fleet ship's main equipments are manufactured by various nations, therefore, non - standardized. The ship's maintenance needs form a very important portion of logistic supply system. This complicates material management, and requires much more manual work than a standardized system. Sometimes, material redundancy (overstocking spare parts) means a "wasted" budget.

Another problem with ship's equipment is a mix of modern and old technologies. This required capable, broadly trained technical personnel. But ROKN's own education center has trained most of the ship's technical personnel. Only occasionally, ROKN headquarter has requested an overseas manufacturer's technical representative or scheduled on-the-job- training (OJT) course for a limited number of shipyard and ship's personnel.

The modernized ROK domestic electronics industry has begun production of the necessary marine equipment. It will take at least 5 years before the old equipment will be replaced with modern machines made in Korea. Then ROKN

should be relieved of the burden of logistic supply problems.

Earlier this year, a privately owned electronics company developed a personal computer for small firms' office automation needs [Ref. 7]. It could easily be applied to destroyer class ship's automation.

Office Automation should be strongly considered in selecting microcomputers for the ROK fleet destroyer class. Two or three years from now this system, will be compatible with internationally developed peripheral components (printer, disk drive, etc.). Then there will be no difficulty in fully applying non-tactical data processing systems to ROKN fleet units.

III. SYSTEM DESIGN CONSIDERATION

Installation of microcomputer systems in ROKN destroyer class ships should be strongly considered. ROK's national economic plans rely on continuing progress in the computer area. In early 1982, efforts by civilian computer firms resulted in an ROK electronic company producing a general applications home computer. However, this small system can not be applied to the shipboard environment. It consists of an 8-bit microprocessor with limited operating and application software and minimal memory capacity. Due to these limitations, the ROKN can not use the national (Korean) technology at hand.

Therefore, foreign technology must be considered. If ROKN must purchase foreign products, many problems will surface: (1) system maintenance, (2) system reliability and later (3) system compatibility with ROK internally developed technology. Additionally, the combatant ship has many limitations which must be considered in the installation of microcomputer systems (1) limited space, (2) ship's vibration, (3) temperature (4) humidity (5) electric power system and (6) continuous sea periods of up to two months from base.

A major problem facing increased use of technology aboard the ships is that the fleet crews do not want the

installation of micro-computer systems onboard ship. They feel that the microcomputer system is additional complex equipment that will increase their burden; (learning about microcomputer operation, maintenance, keeping files, etc.). To remove the crew's misgivings, computer systems to be installed should be easy to use (data entry, retrieval and generating), with emphasis on considering available software packages, such as data base systems and word processing systems.

A. ENVIRONMENTAL CONSIDERATIONS

Installing additional data processing equipment on surface combatant ships will not be easy due to the limited space. All the ship's space was designed for work or living (include office), machinery and miscellaneous support. On the newer, as well as older ship's, the crew would be pressed to find space for additional ADP system packages and physical storage. The microcomputer system approach becomes attractive considering available space. Finding space to put equipment on a ship is not the only determining factor. The space temperature, humidity, cleanliness, vibration and special power available are also major considerations. [Ref. 8]:

1. Temperature, Humidity and Cleanliness:

Most microcomputers will operate reliably within a range of about +50 to +90 degrees Fahrenheit and with

humidity from 20 to 80 percent (non condensing). In the ROKN destroyers, spaces are air conditioned for the crew's living quarters and electronic equipment rooms. Therefore, it is not necessary to add additional air conditioning equipment. If a microcomputer system will be in a dirty or dusty environment, an air filter should be provided for this system.

2. Vibration:

Continuous vibration exists in most shipboard spaces during normal steaming. This is a minimal problem, but sudden shocks can be dangerous to the equipment. If the microcomputer system is installed in locations near weapons and other shock producing machinery, the equipment should be mounted on standard shock-absorbing bases.

3. Special Electric Power:

Most of the microprocessors operate on five to twelve volts. However shipboard power supplies are not regulated and ships often have power fluctuations, partial blackout and complete loss of electrical power. Installation of a self-regulated power supply for safe system operation is mandatory. The ship service electric power should provide a continuous battery charge, with the system running off the battery if power fails.

B. SYSTEM RELIABILITY

Reliability of the microcomputer and peripheral systems are very important to ROKN fleet units, which are located far from most manufacturers. Even if a manufacturer's agency is located in ROK, it would provide limited support for shipboard microcomputer systems.

Typically, there are two commonly used criteria to evaluate reliability [Ref. 9];

- Mean Time to Repair (MTTR); How long will it take to fix it? Sometimes, several hours might be required.
- Mean Time Between Failures (MTBF); How long will an ADP systems run before it fails?

Another ambiguous evaluation method is to attempt to determine company reliability. The criteria used are based on manufacturer's major components of the system, size of company, and financial capability.

C. MAINTENANCE

The most effective microcomputer system in the ROK fleet units would be worthless, when, if a failure occurs it failed to serve the user's request.

There are two possible maintenance methods that could be used onboard ship. The first is to carry "spare kits" (main system board, power supply, display assembly, keyboard assembly, etc.) onboard for each computer in a system. This allows immediate repairs by on-board technicians. Such "spare kits" should be easily supported by the local agency. It is, however, not recommended unless skilled technicians

are available. Bad components can be located by appropriate diagnostic software, and could be replaced by technicians. To this end, integrated circuits must have sockets and can not be soldered in place. This may cost more, but will be worthwhile, even if civilian technicians must do the work onboard the ship. [Ref. 10]

Secondly, system swapping can be utilized. If the price of microcomputer is low, the ROKN can afford to purchase two or more systems. While a defective part or device is being shipped or delivered, programs still can be run on the secondary system.

A training program for user and maintenance personnel would be extremely effective toward maintaining microcomputers onboard ship. The popular word processing, data management and spread sheet software have these packages available. These are considered a good tool to start off novice users.

D. SYSTEM EXPANDABILITY

System expandability should be carefully considered in future user (ROKN fleet unit) requirements. There are several ways in which a microcomputer can expand: more random access memory; multi-user; more on-line storage; communications.

Many microcomputers cannot adapt memory beyond that supplied with the machine. Even some of the 16-bit micro

computers have much extended capability, from 256K to 16 million bytes memory. The advantage of more usable memory is that user can solve larger, more complex problems. If the question is one of a multi-user system, it will even need more memory, facilities for adding terminal support hardware and a multi-user operating system. Initial system design begins with a single user system, but it can be expanded by user requirements. For example, Digital Research offers CP/M (Control program for microcomputers) for single user systems and the CP/M compatible MP/M (multiprocessing monitor control program) for multi-user applications. [Ref. 11] Therefore, it is important to choose a micro-computer with the capacity for growth to permit it to support other functions as they are identified during it's life.

E. SYSTEM COMPATIBILITY

There are few real standards in the microcomputer industry. When considering micro components, no two products, from two different companies will prove to be perfectly compatible.

In the future, ROKN fleet unit's ADP system should be developed with compatibility of processes and equipment in mind. Compatibility in this case, is the best way to save naval budget. Compatibility within the fleet unit ADP

system must be directed toward several areas; language, operating system, interconnection and processors:

1. Language

At the highest level the compatibility question comes down to the use of a common language and a common media format. The ROKN computer center has adapted COBOL as its primary language, and it should be recommended to the microcomputer user. Many other languages hold substantial promise for the future in microcomputer. Such as PL/1, ADA and even Pascal.

Basic has been around for many years and dozens of implementations have been produced using just about every conceivable operator convenience. However, this language is unstructured and difficult to maintain.

At the present time, the COBOL would be beneficial for the ROKN. Nearly every application a command could use, could be written in COBOL.

2. Operating System

Recently, many different systems using many different operating systems have been introduced. These systems perform general utility and are designed for smooth system operation. Some systems software should be provided by the manufacturer with the equipment; at least one compiler or interpreter and operating system are usually included. The type of operating system supplied is important, because many interpreters and compilers, as well

as applications programs, are designed to run only with certain operating systems. The popular and best-known operating systems for microcomputers are CP/M (Control Program for Microcomputers), Apple DOS, UCSD-P system, Unix, MS-DOS, TRS-DOS, in computers that use disk operating systems for storage. [Ref. 12]

Today, the vendor will nearly always mention operating system compatibility in his advertising. By specify format and using 8-inch sectored disketts, program and data can be transferred between machines without concern for minor hardware differences. Therefore, selection of operating systems which are capable of compatibility with other systems is extremely important.

3. Microcomputer Interconnection

Generally, the microcomputer interconnects with other devices, which can be other computers, or memories, or general peripheral units. These interconnection architectures provide for the availability of micro-processors, the applications of distributed processing and networking system. There are two kinds of architectures in existence. [Ref. 12]

a. Internal Bus

Virtually all of the currently available microcomputers are based on a bus architecture. In this structure, components such as the microprocessor memory, and other peripherals are attached to a common bus, which

provides pathways for communicaions between the various components. The most common microcomputer buses are S100-696, multi bus, S-50 and STD. Selecting a standard bus architecture means that user had a larger selection of possible peripherals, and can often make significant changes, such as changing from an 8-bit to a 16-bit processor, without sacrificing the entire system.

b. External Interface

External interfaces connect the computer with the peripheral devices (Input and Output hardware) by carrying data in either serial or parallel forms.

There are already developed two kinds of commercial external interfaces for microcomputers; RS-232 (Electronic Industries Association Standard) and IEEE-488 (Institute of electrical and electronics Engineers). The latter is a standard parallel interface, which is often used for various high speed peripherals and instrument control, but is less common than the serial RS-232 interface. The user must be considered proper number of ports for connecting serial interface line to connect to all peripherals. Interface ports should be designed for standard interface links; RS-232, IEEE-488 or others, so that they are plug-to-plug compatible with considered peripherals.

4. Processor

Recently, most of the microprocessors used in microcomputers were 8-bit devices, which have some limitations. These are: (1) Size memory (64K byte direct addresses limit) and limit the solution capability of complex problems. (2) The 8-bit microprocessor instruction sets are generally less powerful than those of the newer 16-bit processors. The newer 16-bit microprocessors take advantage of their extended addressing capability to support a maximum of 256K to 16 million bytes of memory, depending on the system.

Although, challenged by the 16-bit microprocessor, microcomputers equipped with 8-bit microprocessors still dominate in sales and popularity. This remains true for several reasons;

(1) Many 8-bit microcomputers still remain in the market place.

(2) Generally 8-bit microprocessor are less expensive than 16-bit.

(3) Many applications are served adequately by 8-bit microcomputer.

Shipboard microcomputer systems should have a capability for an expandable system; allowances should be made for at least one data base system, a word processing system and several specific software packages for ship's requirements.

F. APPLICATION SOFTWARE

Application software is the critical component of any microcomputer system. Microcomputer software development is very expensive. The general user should not consider writing software for a microcomputer.

Fortunately, ROKN fleet unit do not worry about producing applications software, the AMS (American Microcomputer Software) company has already developed for U.S. Navy and U.S. Coast Guard ship's a non-tactical data processing system. The available software packages are as follows: [Ref. 13]

(1) ship's financial software

(2) ship's payroll software

(3) inventory control software

(4) department budget software

(5) food service software

(6) retail store support software

(7) CSMP (Current Ship's Maintenance Project) software

(8) maintenance job request software

A more detailed description of the above will be found in Chapter IV of this thesis.

G. DATA BASE MANAGEMENT SYSTEM

Microcomputer based personnel management system will improve personnel readiness, which means an effort to improve overall ship's material readiness by improving the

ship's maintenance management. Concerning microcomputer based personnel management, which includes many kinds of personnel files, kept onboard ship. There are; (1) personnel record file (2) training records file (3) skill inventory file (4) school requirement file, etc. Often above files common data elements include to all other files. For instance, personnel name, service number are recorded in personnel record file, skill inventory file and other related files. These redundant or duplicated data items cause two major problems; they increase the total amount of file storage space needed, and necessitate multiple updates whenever a change occurs. A solution for the problem of redundant data is to combine files with common elements and eliminate all redundant files. Developing a personnel data base management system will provide for the easy manipulation and control of this complex system of individual files, and automatically perform the following tasks; [Refs. 14, 15]

- data base creation: defining and organizing the content, relationships, and structure of the data needed to build a data base
- data base maintenance; adding, deleting, updating correcting, and protecting the data in a data base.
- data processing: using the data in a data base to support various data processing assignments such as information retrieval and report generation.

This will be developed further in Chapter V.

H. WORD PROCESSING SYSTEM

The ROK has its own language, "HAN GUL", which is used for official business. Although English is taught from middle school, onward, it is only learned by using books written in English. Additionally, the Korea Institute Science and Technique (KIST) developed a word processing software package written in our own language.

The use of software packages and word processing packages, (Wordstar), developed by overseas companies (in U.S. AMS co) should present no problem because Korean commercial companies and bank ADP systems have been converting English keyboards to Korean; also Navy officers and petty officers understand English.

The ROKN destroyer class ship has a lot of paper work, editing text, (technical) books, instructions, notices, ship's bills, standard operating procedures, lesson plans and naval messages. The paper work to support these requirements take a great deal of effort by the ship's crew. To easily review, update and edit this paperwork, I recommend word processing software for ROKN ships.

This system has the capability to select which pages to retype, making small changes easy in large documents. Additionally, it will provide pertinent information to ship-board daily routine schedule, ship's internal correspondence, duty watch assignments, and inspection

check-off-list, etc. Actually, daily major job assignments could be solved by this word processing system.

IV. SELECTION OF THE MICROCOMPUTER SYSTEM

A ROKN shipboard microcomputer system must satisfy various considerations with respect to humidity, fungus, temperature, salt fog, dust and explosive atmospheres. Additionally, it must provide an acceptable performance utilizing available commerical application software packages.

At this time, many acceptable microcomputers are available. However, the many advertisments and the salesperson's "golden word" have been extremely confusing and have made selection very difficult. I intend to recommend this selection from a narrow portion of the microcomputer market, in regards to application software packages and hardware.

A. AVAILABLE APPLICATION SOFTWARE MODULES

About twenty software modules have been developed for the U.S. Navy surface ship's microcomputer systems by the AMERICAN MANAGEMENT SYSTEMS COMPANY (AMS). In 1982 Lieutenant Harry F. McDavid, USN, developed a manual for shipboard financial and inventory management systems. It was utilized very successfully in USS King [Ref. 6].

The U.S. Navy has installed and used microcomputer based ship's office automation systems. Additionally, the U.S.

Navy has requested civilian software development companies to simplify and develop additional applications for other areas onboard the ships. As a result of these efforts, additional modules have been produced around other shipboard areas as applied to microcomputer based management.

The ROKN should attempt to utilize and develop non-tactical data processing software packages through established U.S. and Korean military sales channels. An additional alternative will be for the ROKN to directly negotiate with the American Software Systems Company. If ROKN chooses the latter, it will provide a greater advantage to the ROKN; the applications should be demonstrated for the ROKN aboard a fleet unit. If this is done successfully, these software packages will be complete as well as easy to use. Thus the ROKN can be supported without extensive system modification. Specification of the modules are as follows: [Ref. 13]

1. Ship's Administration Department

   a. Personnel module: provides for recording, creating files and generating reports about shipboard personnel management.

      - service record
      - billet
      - qualification and assignment

   b. Medical module; provides automated medical diagnostic record keeping and report generating.

      - physical examinations
      - dental examinations
      - immunization maintenance

c. Physical security module; provides for personnel reliability program, visitor control, weapons control.

2. Operations Department

a. Training and readiness module; keeping status of each training event as well as scheduling data and a training event description.

b. Event scheduling and operation planning module.

3. Engineering Department

a. Configuration module; provides for onboard equipment inventory and consolidated shipboard allowance listing.

b. Planned maintenance module; creating files (weekly, monthly and quarterly), maintenance actions, measurements or reading which exceed established range and other condition recording, providing work requests.

c. Fuel management module; inventory control and fuel consumption schedule.

d. Technical Library module; creating files concerning machine and material history, major maintenance.

4. Supply Department

a. Storekeeper financial module; provides for material requisition control; ordering (document preparation), follow-up, status update and tracking, file maintenance; financial obligation and management; material obligation validation program

b. Stock allowance module; material issue, receipt, high and low safety level assignment, reorder and survey

c. Subsistence module; food ration control,. food inventory control, financial management

5. Purser Responsibilities

a. Budget consolidation module; ship's operational targeting financial status, allow each

department to determine balance, and report generation.

b. Payroll module; creating payroll file and record keeping.

c. Ship store module; inventory control and financial management.

B. CRITERION FOR SELECTION OF A MICROCOMPUTER SYSTEM FOR ROKN

In Chapter III system considerations and ROKN combatant ship's requirements were determined. However, the proper choice of one out of a hundred choices of microcomputer systems remains very difficult. Additionally, without standard specifications comparisons are extremely difficult. This chapter will give the general specifications and requirements for a microcomputer system for the ROKN and provide the means to narrow the selection process until only one system is finally presented for acceptance by the ROKN.

1. Microprocessor

For the present, 8-bit chips are in the majority within the microcomputer world. There are four widely available units; the 8080, Z-80, 6502, and 6800 - only Z-80 and 8080 chips are supported by the majority of software. However, the 6502 and 6800 are doing well within the "home" computer area, even with limited developed software for business use. The Z-80 is directly compatible with all 8080 software, since the 8080 instruction set is a subset of the

Z-80 set. Figure 4.1 [Ref. 16], shows that a significant majority of microcomputers implement a Zilog Z-80 processor.

The 16-bit processors have faster execution speed, good performance for complicated problems and more expansion capacity. However, this system does not have the available software packages as the 8-bit microprocessor now has. In the future, 16-bit chips will gain more popularity than 8-bit chips, probably for the above reasons.

Recently 8 and 16 bit processors have been combined to create dual processor systems incorporating an 8-bit processor, (like the Intel 8088). This system can run both 8-bit software and 16-bit software to provide a bridge from the 8-bit to the 16-bit world. Generally, dual processors are combinations of 8080/8086, 8085/8088, Z-80/8088, Z-80/68000, etc. [Refs. 12, 16].

The following are the most popular chips used in the microcomputer world.

8-BIT

- Z-80 : ZiLog
- 8080 / 8085 : Intel
- 6800 : MOTOROLA
- 6502 : MOS Technology

16-BIT

- M68000 :MOTOROLA
- 8086 / 8088 : Intel
- Z800 : Zilog

The ROKN's available application software was designed for 8-bit or 16-bit microprocessors. (8-bit chips

are internally developed by several Korean companies.) Therefore, more effective and flexible usage chips such as dual processors should be utilized within ROKN shipboard computers. If the ROKN selects a dual processor, there are obvious advantages. The ROKN can take advantage of internally developed and externally useful 8-bit and 16-bit software packages.

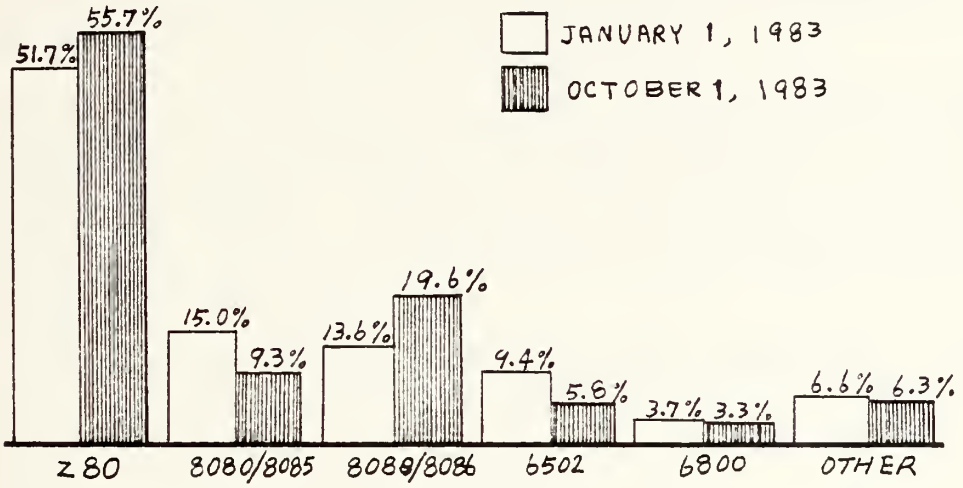


Figure 4.1 Microprocessor Chips in the Market

2. Operating Systems

Most microcomputers have their own operating systems. At the present there are around 40 operating systems in use. The most popular operating systems are as follows; [Ref. 17]

- CP/M: This is the "standard" operating system for 8-bit computers, (running on more that 300 models). Additionally, more than 3000 software programs have been developed for use with CP/M. This operating

system is designed for use with the Z-80 or 8080 8-bit processors.

- CPM/86: varies only slightly from CP/M. A major attraction of this 16-bit operating system is that large amounts of CP/M software has been converted to work with it.

- MS-DOS: This system designed for 8080/8088 family of processors. MS-DOS runs on more than 80% of 16-bit microcomputer systems. Recently, IBM selected this system as their primary operating system for its personnel computer. This system was developed only two years ago, but manufacturers have "churned" out around 2000 programs for MS-DOS. In the future, software written for it will continue to be designed primarily for professional needs. This system is easy to learn but powerful for 16-bit computer usage.

- Unix: This system was, until recently used only by scientists and engineers on large computers. The Bell Company developed this powerful system to utilize the microprocessor. To date, little software has been written for this system but it is popular for those applications with sophisticated needs such as scientific analysis.

Previously mentioned application software packages (developed by AMS) require 8-bit CP/M or 16-bit MS-DOS. Any ROKN shipboard computer should be able to provide more advantages because it can interface with internally (Korean) developed word processing software.

3. Memory

This term refers to a computer's random-access memory (RAM); essentially it is a gauge of how much information a machine can handle at one time. Most 8-bit microcomputers are limited to 64 K bytes. However, several systems can be expanded to one million bytes (eg. Digital Computer OMNI, Morrow Designs Decision 1, etc.) [Ref. 18].

With this in mind, the ROKN should develop a data base system, (considering multiuser systems), with this memory limitation and expansion capability in mind. Generally, data base systems require at least 48k bytes of memory capacity. Recommendations for at least 64k bytes and expandable memory capability systems should be considered.

4. Language

Most microcomputers are sold with at least one version of BASIC (Beginner's All-purpose Symbolic Instruction Code) language. Written BASIC language programs are often confusing and hard to read, since the language is not highly structured.

At the present, several high level languages are being used in microcomputers; BASIC, COBOL, FORTH, FORTRAN, LISP, LOGO, PASCAL AND PILOT, etc. [Ref. 19] Lately, popularity has grown for the use of Pascal in microcomputers. It is more a orderly language than BASIC and allows programmers to write more complex programs faster.

For a long time, the primary language of the ROKN computer mainframe has been Cobol; sooner or later ROKN shipboard computers must be interfaced with these mainframes. Shipboard microcomputer systems should be developed with BASIC and Cobol (Optional) language available at installation time, with additional languages added as the need arises.

5. Peripheral Systems

a. Mass Storage;

Generally, mass storage is represented by Cassette recording tapes, floppy disks and hard disk drives. [Ref. 20]

- Cassette recording tapes: these are not being used in business because their storage locations must be accessed sequentially. Additionally, they are slower to access and less reliable than disks. This system is very inexpensive compared with disk systems but it is still unattractive since other mass storage systems costs are decreasing.

- Floppy disk system: This is a circular flexible sheet of Mylar with a magnetic-oxide surface on which data can be recorded in tracks and from which data can be read by read / write heads of the associated disk drive apparatus. This system can be directly accessed. Here, storage capacities are constantly increasing. A very rough guide is that one floppy disk will store anywhere from 80k to 2 megabytes (equal to approximately 40 to 1000 double spaces typed pages.) Common disk sizes are 8, 5 1/4, 3 1/2, and 3 inches. Generally 5 1/4 and 3 1/2 inch disk systems are more popular, because they have been available longer and the costs are more reasonable than other. [Ref. 12]

- Hard disks systems: These work on a similar concept as floppy disk systems, but they provide a much faster access time and greater storage capacity, but they are much more expensive. There are a number of different hard disk arrangements. One of these the "Winchester Drive" system is the most practical and economical for a shipboard microcomputer environment. Winchester Hard Disk storage capacity presents from 5 to more than 100 million characters. This system has sub-4-inch, 5 1/4-inch, 8-inch and 14-inch size of disks. The popular one is 5 1/4 and 8-inch for microcomputer. The data storage capacity is as follows: [ref. 12.16]

. 5 1/4 inches Winchester Hard Disk

MODEL	PER DRIVE MEGA BYTES	AVG. ACCESS TIME	DISKS
D-507	6.38	80	1
D-514	12.75	80	2
D-519	19.13	80	3
D-526	25.5	80	4
D-720	26.9	35	2
D-740	44.9	35	3

. 8 inches; data storage capacity 62.9 - 157.5 M Bytes

ROK internal industries has produced 5 1/4 inch floppy disk systems for the past year. However, ROKN combatant ships have an approximate input data volume of at least 10 M-bytes for crew's personnel management and inventory alone. Therefore, one 5 1/4 inch Winchester Hard Disk (model D-514) system for data storage, and an additional two floppy disk drive systems will be required to support ships requirements.

b. Printer:

To retrieve data from a microcomputer and onto paper, a printer is required. Generally, the criteria for selecting printers will present trade offs of quickness for quality or vice versa. Speed demands usually indicate a need for a dot-matrix printer, whose speed rates are around 3 times faster than letter quality printers. For example a page of 150 words that requires 27.3 seconds with a 55 cps letter quality printer will require only 9.4 seconds to print with a dot matrix running at 160 cps. [Ref. 8]

If ROKN chooses letter quality printers, it will provide a complete character image similar to a traditional typewriter. Within the ROKN, onboard generated reports and formats do not require letter quality. Modern high quality dot-matrix printers can provide excellent print quality for internal and external generated reports for the ROKN.

c. Keyboard:

There are many keyboard layouts; none are perfect. All manufactures begin with the standard "QWERTY" arrangement of alphabetic and numeric keys. Depending on the keyboard designer, some of the following keys are added, in different positions; function keys, control keys, numeric pad, cursor control keys, etc., Therefore it it recommended that the ROKN's keyboards will be standard "Qwerty" arrangement keys, plus special purpose keys which will provide more time saving text entry, editing, more efficient software development, and use of software language available now and later. Examples of this arrangement are control, caps lock, escape, reset, arrow (up, down, left, right), tab, and delete keys. [Ref. 12]

d. Display:

Various colors and size of displays are available. Television sets can be used as computer video displays but they are not appropriate for word processing. The TV set does not produce the sharp images produced by monitors; monochromatic monitors (green and black, amber and

black, black and white, composite color monitors (colors are mixed) and RGB monitors can produce truer colors). [Ref. 17]

The ROKN shipboard process does not require composite colors and RGB monitors, Those are more expensive than monochromatic. Monochromatic monitors with green or amber screens are popular models in business and they reduce eye strain. It is recommended that monochromatic monitors be provided to the ROKN. Additionally, consideration must be given to display sizes. Generally, 80 characters by 24 lines monitors is an acceptable minimum size. 80 X 24 format is a compromise between the largest amount of data that could be placed on a display, and the most readable character size. On a 12 inch display, the density and character size of the 80 X 24 format is ideal (Ref. 8). ROKN should purchase monochromatic (green or amber) with 80 X 24 format, 12 inch monitors.

e. System Interconnection:

In the previous chapter internal and external interface architectures were mentioned. The systems recommended are;

- internal interface: S-100 system
- external interface: "RS-232" (serial), and "IEEE-488" (paralled) system

6. Data Base Management System (DBMS)

Up until now the most widely used DBMS systems for microcomputers are Selector V by Micro-AP Inc., dBase II by

Ashton-Tate, FMS-80 by System Plus, Condor III by Condor Computer Corp., Analyst and Qsort by Structured Systems Group. These systems general information is exhibited in Appendix A. Systems features are as follows; [Ref. 21]

a. Analyst and Qsort:

this DBMS is inexpensive, works well, and has excellent documentation. However it is too slow in bring up program menus and has limited report generating capability.

b. Condor III:

It has a good screen and report generator and the programming language is the easiest of all DBMS. Usually, Condor is well suited for accounting applications because a number of commands are tailored for that specific use.

c. dBase II:

The strongest points of this DBMS is its ability to access a data file rapidly and to find and display (or print out) single or groups of logically selected records with a minimum of operator direction. The program language is additionally very flexible for complex applications.

d. FMS-80:

A formatted report capability is available but it is too complex to set up. Initial set up of the applications of this program should be done by experienced programmers, It is more time consuming in the addition of new records.

e. Selector V:

Runs as fast or faster than the assembly language coded DBMS's and has definite strengths in multiple file accesses. The current version cannot easily select and display or print groups of records and formatted report outputs are complex to generate.

Software packages previously mentioned, are written in dBase II language. The U.S. Navy has revised this system for shipboard microcomputers. Generally, the dBase II system has been developed and used for a long time in comparison with the other newer systems.

ROKN should approve the purchase of the dBase II system because when they chose a dual processor system which runs CP/M and MS-DOS operating systems, the dBase II system will be well suited for those capabilities.

7. Documentation

Too many times this requirement is ignored when developing a microcomputer system. Without adequate documentation, the most useful shipboard microcomputer system can become partly or fully obsolete long before its normal life expectancy. Before final selection of a microcomputer system by the ROKN is complete, confirmed hardware and software manuals or operating procedures must be available. These will serve as a ready reference, provide for problem identification and training once the system is installed.

C. AVAILABLE MICROCOMPUTER SYSTEMS

Around 460 types of microcomputers have been announced since 1 October, 1983, (Figure 4.2). The microcomputer "explosion" has had far reaching effects, as the systems gain in power and applications and simultaneously decline in price. [Ref. 16]

Consequently, it will be more difficult to properly select microcomputer systems without special features. It will be necessary to narrow the field of systems acceptable to the ROKN requirements. The most significant areas of interest are as follows;

- installed dual processor (8 / 16-bit)
- can operate CP/M and MS-DOS operating systems (required application software packages)
- should satisfy the criteria of selection microcomputer for ROKN (previously mentioned)

Available are 40 systems with installed dual processors. They include very small and newly established companies, because the new systems (dual processors) were offered only two years ago. As applied, the requirements for operating systems (Appendix B) meet the requirements set forth for the ROKN surface ship acquisition program.

D. RECOMMENDED MICROCOMPUTER SYSTEM FOR ROKN

Although all above microcomputer systems have an excellent performance capability. The ROKN cannot spend excessive monies without a cost evaluation. The

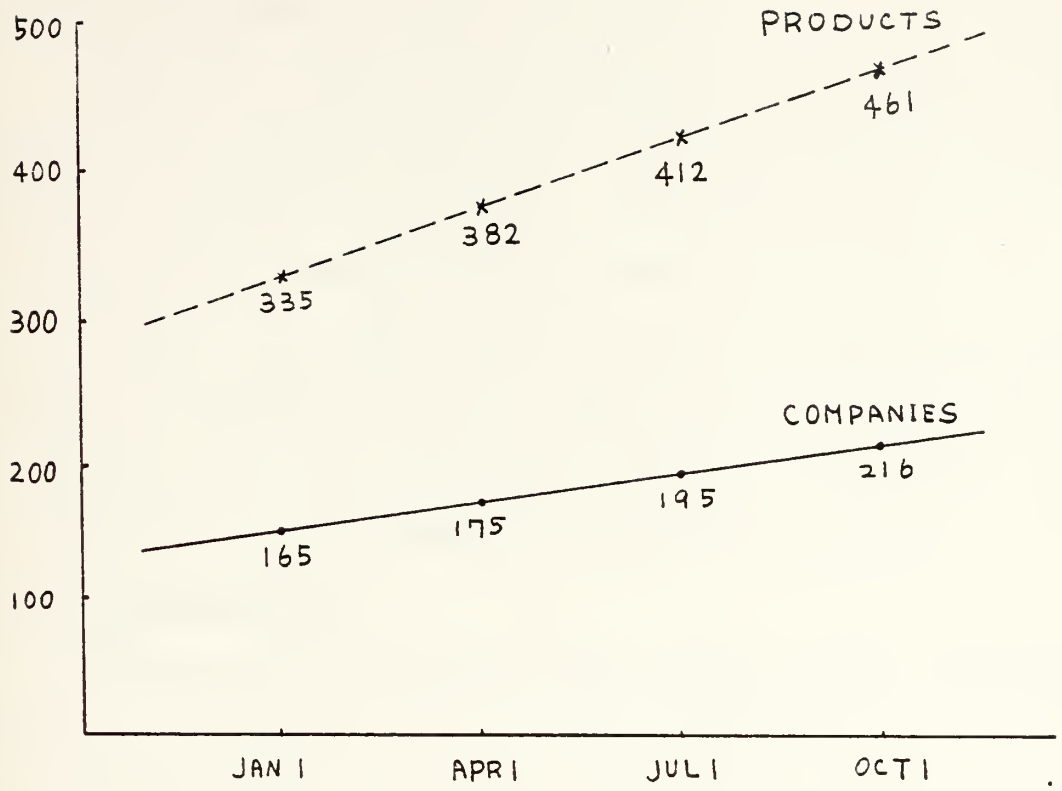


Figure 4.2 Growth of the Desktop Microcomputer (1983)

microcomputer (desktop or personnel) systems price is not exorbitant compared to its mission contributions. Briefly system cost is presented for consideration:

1. Total System Cost

A complete shipboard microcomputer system should be included in the basic machine (CPU, full memory, I/O ports, etc.) two floppy disk drives, printer, display monitor, keyboard and system operating software. Lately in the marketplace we can purchase the above basic system for under 5000 dollars. If the system is to be expanded, money must

be spent on purchasing application software, hard disk drives and peripherals.

Last year the U.S. Navy contracted with Zenith, Data System (Z-100 Series) for about 3500 dollars for single shipboard microcomputer system. The ROKN could purchase this system on U.S. market for the same price. [Ref. 13]

In any case, ROKN could install the entire system for under 10 thousand dollars, which includes basic system plus several application software packages, Winchester hard disk (10M bytes) and the dBase II data base system.

2. Recommendation

Although the previously selected ten dual processor microcomputer systems all satisfy the ROKN requirements, they still have some drawbacks. The most important point should be maintenance of the system. The ROKN is located far from manufacturers, and all of them were established after 1975. Several manufacturers are very small and have weak financial foundations. Others are well established, financially sound companies, (Appendix C). If ROKN selects their microcomputer from small companies, they possibly will not have on-site maintenance service. Additionally, the ROKN must be concerned about manufacturers going bankrupt. To avoid these risk, ROKN computer system should be selected from the larger companies. It is not easy to evaluate microcomputer companies without manufacturing policy,

analyzing their income statement, and their capability within their competitive groups.

Appendix C, notes available system manufacturers. I recommend three companies products; Zenith Data Systems (Z-100 series), NCR Corp (Decision Mate V) and Fujitsu (Micro 16s Personal Business). Last year (1982) all had over one hundred million dollar sales, and their products are proving to be the most popular in the microcomputer world. [Ref. 16]

a. Zenith Data Systems (Z-100 series);

Last year the U.S. Air Force and the U.S. Navy contracted for this system. The U.S. Navy has a planned installation onboard many ships. This company's major products are; computers, printers, disk equipment, terminals, monitors and application software.

b. NCR Corp (Decision Mate V)

NCR is one of the biggest companies in the computer world. Major products, from small business computers to large computers, peripherals, office automation products, data communication network, and soft -ware are available from this company. Additionally, NCR has distributor and service centers in over 120 countries.

c. Fujitsu Microelectronies (Micro 16S [personal, business]);

Is the biggest computer manufacturer in the world. The parent company is located in Japan (Fujitsu. Ltd.) ROKN could easily approach this company.

So far, I have recommended three models of microcomputers whose products have the best possibility of successful installation onboard ROKN. Before purchasing a microcomputer system, the ROKN should develop a project team, and install one of each microcomputer system onboard ship to test performance. At the end of one year the project team will make an evaluation as to the results, then select the best system. Without application test the ROKN cannot select microcomputer systems. The ROKN should strongly recommend the above selection method.

V. DBMS FOR SHIPBOARD MICROCOMPUTER SYSTEMS

Up until now, several types of microcomputer-based database software packages have been introduced into the market place. Usually these can be divided into menu-driven and language-driven systems. Menu-driven packages such as Condor and Datastar are easy to learn and operate. The language-driven packages such as dBase II and FMS-80 require users to use commands rather than selection menus. Command-driven DBMS is more powerful and fast in the hands of experienced users. [Ref. 23] However, both types have strong and weak points depending on the interface user's job and intentions.

The DBMS software package recommended earlier was dBase II. The dBase II system, is the most effective system for use onboard ROKN ships.

In this chapter, the following subjects will be presented:

(1) database concept

(2) three models of database

(3) database selection

(4) dBase II features, compared with file management database management

(5) how it's effect on ship's managers decision-making.

A. OVERVIEW OF A DBMS

A simplistic definition for DBMS could be considered a software tool that permits a user to correct, store, and access a volume of data without regard to its physical storage. Properly organized and used, a DBMS will facilitate a wide variety of access techniques and greatly reduce the redundancy of data.

Depending on one's point of view, the DBMS could either be thought of as a servant to the user's applications, or the applications as a servant to the DBMS. However, the user doesn't have to concern himself with where the DBMS stores the data, or from where it gets it from when the user requests it. [Ref. 24] Figure 5.1 shows relationships among DBMS, DataBase System elements and users.

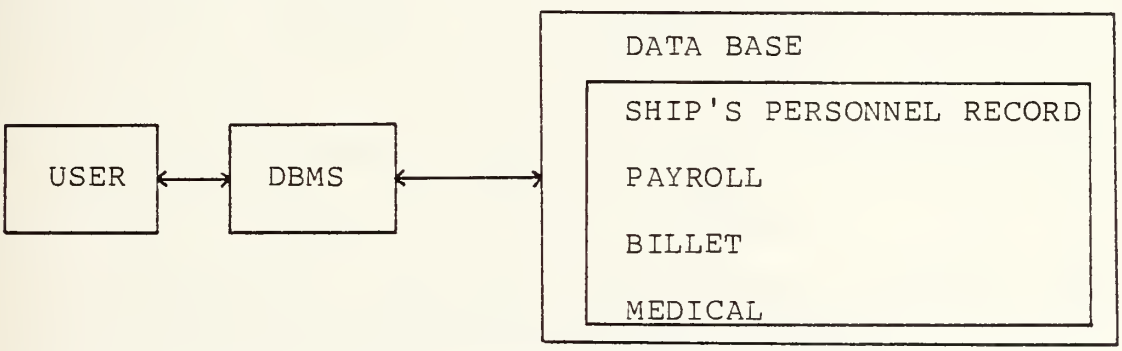


Figure 5.1 Relationships Among DBMS, Data Base Elements and User

B. DATA BASE MODELS AND A MODEL SELECTION

In general, there are three predominant data models associated with DBMS's. The three are the Hierarchical model, Network model, and Relational model. In this

section, the above terms will be described and provide information to allow users to see where a desired DBMS will fit into the structure.

1. Hierarchical Model

The Hierarchical model is tree-structured, with different record types, related in a "parent" and "child" manner. In this structure, a parent may have many children, but a child has only one parent. This is normally termed as a "one-to-many" structure. (Figure 5.2). Implementations of hierarchical systems normally use indexing, or pointers, to make connections between records on the tree. Without such structure information, the listing is ambiguous. Additionally, this model must be processed sequentially from parent records. If processing records are in a large hierarchical structure, the system should be able to read the whole structure until the data is found. This model is not efficient. The following attributes are attractive to user [Ref. 24], when researching a system:

1. A system must provide an easy access to produce data.
2. The system must provide a simple structure.
3. A system structure must be easy to read.

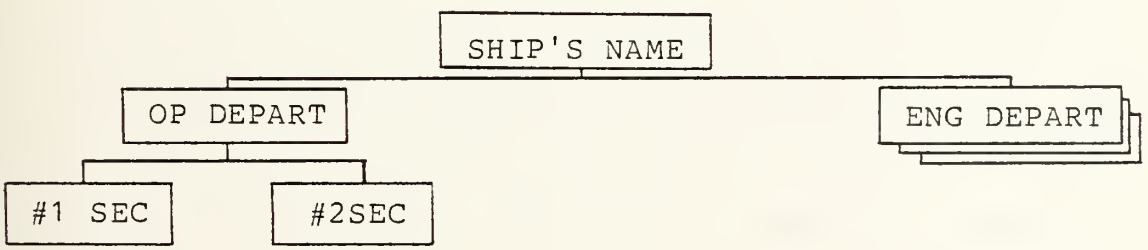


Figure 5.2 Hierarchical Model

2. Network Model

This model is similar to the hierarchical system in that it uses a tree-like structure. The major difference is that in the Network model, the records may have pointers establishing "many to one" or "many to many" relationships. (Figure 5.3) The primary advantage of this model is it has more flexibility than hierarchical structure and can represent very complicated data structures with a relatively simple graph representations, difficult and data manipulations can be performed [Refs. 24, 25].

3. Relational Model

This model can be thought of as a collection of two dimensional tables. One dimension of the table would be a record, which is collection of data items; the other is fields of the record; which is the smallest unit of data. In a table, all records would be of the same type. The connection between different tables would be by the relationship of the data in the corresponding fields of the records and not by record-type pointers.

Otherwise, it is the data that creates the relationship and not the structure. This model's major disadvantage is, that data is duplicated in the relations. In Figure 5.4, crew's name is duplicated three times in different fields of the record. This model does, however, have advantages: (1) it is easier to implement and (2) make

modifications and change the data or application programs. [Refs. 22, 24]

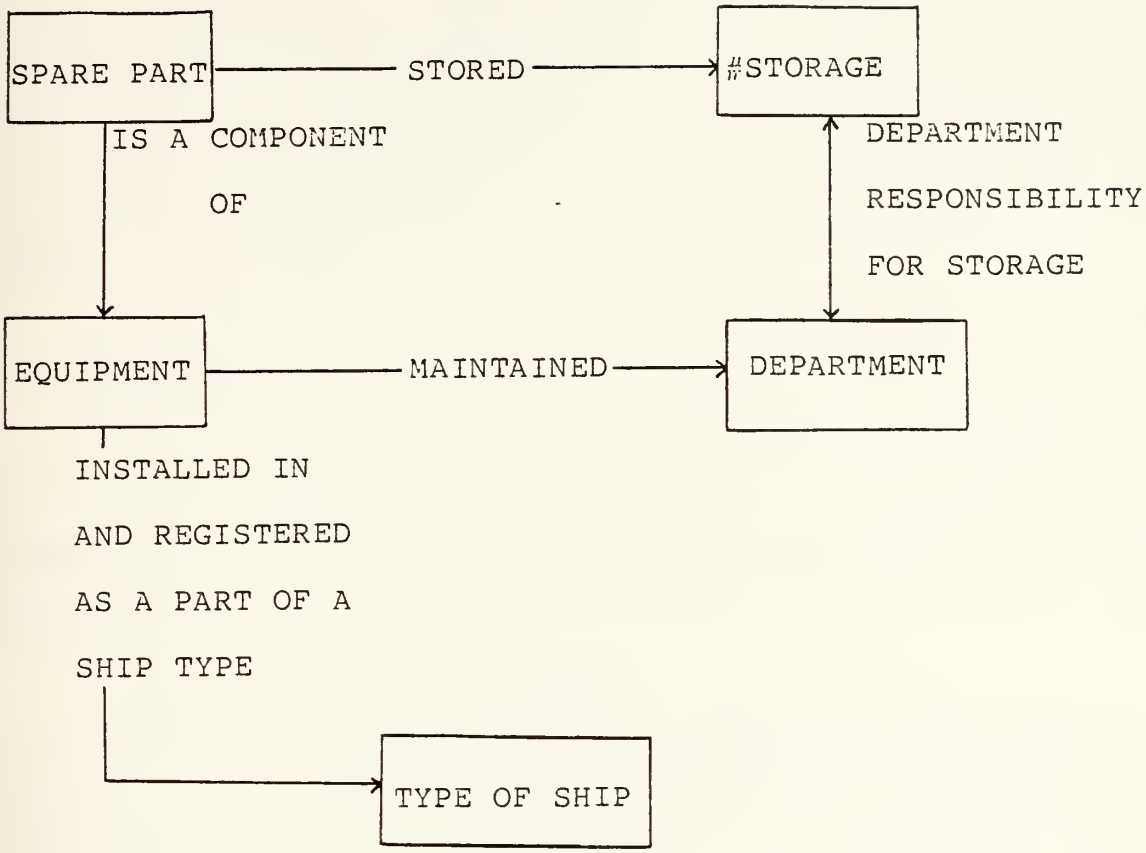


Figure 5.3 Network Model

Rank	SSN	Name	Birthday	Department
SSN	Name	Position	Years Ser	Salary
Rank	Name	Address	Phone	Dependents

Figure 5.4 Relational Model

Commonly, a DBMS for microcomputer systems can be either hierarchical, network or relational models. One additional definition of relational model is that no user visible links pre-exist between tables, and links between

tables are created dynamically upon request. Both hierarchical and network models require pre-existing links known to the user. Due to the need for such links, hierarchical and network systems require complex physical design and are much harder to understand [Ref. 24]. The relational model is the most popular in the microcomputer world.

C. INTERFACE DBMS

The user program or application is written in terms of high level language which must have some interface to the DBMS. There are three different interfaces defined for the DBMS [Ref. 24]

1. Data Definition Language

This is used to define the structure of the database. This term is very important to the user because it provides a description of records, fields, relationships; identification and keys. It also expresses the user's views and additional constraints (edit, enter-record).

2. Data Manipulation Language (DML)

This is used for describing the processing of the database. Facilities are needed to retrieve, replace and delete records and processing data in logical rather than physical terms. Because it is independent of programming language, it is easy to interface between user and DBMS.

3. Query Language

Allows the user to evoke information from database. If the user desires regular reporting, it will increase the productivity for the user. Because a user can interact directly with the database system using English-like commands, it can be used for application programs as well as query-language statements.

D. dBASEII FEATURES

The dBaseII is a relational DBMS, designed especially for microcomputers. It will presently operate on any microcomputer which is capable of using the CP/M or MS-DOS operating system. It operates with versatility of use in mind, in that it can be effectively used by a user or organization with vastly different needs and requirements. It is equipped with powerful commands which permit rapid retrieval and update of information based on user specified criteria.

The dBaseII can be used to create "menus" of commands or prompts to guide a user through a sequence of events. This is especially useful where a system is to be used by clerical or generally administrative personnel with little computer background. The following give additional advantages to shipboard personnel [Ref. 26, 27]:

1. easily manipulated data, files
2. data and program independence; when changing data, it is not necessarily change programs and vice-versa

3. generates reports from one or more databases.

4. Using the full-screen editing capability, simply fill in the blanks on such items such as financial management spread sheets.

E. IMPACT OF DBMS ON SHIPBOARD MICROCOMPUTER-BASED MANAGEMENT

In Chapter III, "Why should the ROKN establish a DBMS?", was briefly explained. This section will show how DBMS effects the shipboard managers and delineates the benefits to the ROKN.

The ROKN's present system are faced with changing technology in computer-based information system. Accompanying this growing trend is a need to increase file size and the number of programs to be maintained relative to present application programs. Due to .the above those problems, DBMS for microcomputer based systems could be most effectively performed for the ROKN as follows;

(1) Low cost data handling; eliminate duplicate data. It uses expansion memory space, and reduce memory cost.

(2) Manpower savings: programing and program maintenance efforts will be decreased, using query language and maintainable independently from data.

(3) As a decision support tool; for fleet bases or section shore base head-quarters, who will support a decision-making, it could be a important operation or timing of overhaul, and any other operations. It will be a difficult or risky decision, because they can not get accurate data from ship's manuals or file management systems.

The ROKN should apply DBMS systems to be used as a management tool onboard ship. This will give less ambiguous

information to the ship's manager or shore-based headquarters. Additionally, it will provide, (1) improved internal control, (2) better management awareness of problems and opportunities (3) faster response to changes in operating environment.

If the ROKN ignores this system and continues with the traditional or file management system, it cannot improve the effectiveness or economical operations onboard its ships.

VI. CONCLUSIONS AND RECOMMENDATIONS

The focus of this Thesis is on the recommendation for a microcomputer system for shipboard management on board ROKN combatant ships. Lately, many computer systems have been established with no "rules of thumb" as to how to select computer systems. Actually, without implementation and testing, it is important to choose the "BEST SYSTEM". This could be defined as developing performance requirements which indicate the least cost and least risk. To reduce these ambiguous factors, descriptions and recommendations will be delineated in a step-by-step manner.

1. ROKN's fleet requirement: to reduce the manual administrative workload and apply microcomputer based data management and word processing systems.

2. System design considerations: combatant ships have distinct features: limited space, salt air, vibration and continuous sea duty.

3. Selection procedure: specific hardware and software requirements.

I considered the above factors, and searched for the systems that would contribute a manner of effectiveness to the ROKN. Until now, ROK domestic microcomputer products have not fully developed to allow applications for shipboard use. Therefore, I have searched the U.S. and Japanese market, noting 20 systems. The ROKN need not test all of them onboard ship to choose the best system. I have

narrowed this selection to 3 systems by limiting the available sizes: 1. Z-100 (Zenith); 2. Decision Mate V (NCR); 3. MICRO 16s (Fujitusu Microelectronics). Although these machines are most effective and popular in business, they do not satisfy all ROKN requirements. I recommend a one year onboard testing program. Additionally, the ROK should develop an 8-bit (CP/M) system internally that can be tested onboard ship. In the future, it will provide increased benefits to the ROKN for reduction of conversion costs. After completing these test periods, the ROKN should evaluate and select the best system. The chosen system will increase the ROKN fleet level management effectiveness, increase the quality of the ship's administration, reduce onboard paperwork and facilitate the accessibility of information for better decision making, computer literacy, and job satisfaction. As result of the above, the ROKN will increase military effectiveness and operating efficiency at all levels of command. Finally, the ROKN should continue to study the following areas within the computer related field:

1. System standardization and networking: equipment, Input/Output generated reports to communicate with other shore bases or between ships.

2. Develop decision support systems model; how long or when to schedule ship's overhauls and operating periods; the placing additional or removing unnecessary shipboard equipment, etc.

Lastly, I strongly recommend that all fleet units develop a microcomputer system for shipboard use to further establish an integrated information system.

APPENDIX A:
Statistical Information of DBMS

DBMS	Operating System (8-bit)	Operating System (16-bit)	Memory Requirement (bytes)	Max records per file	Max record length (bytes)	Screen Editing
Analyst and Qsort	CP/M and MP/M	not available	48K	65,535	255	line oriented
CondorIII	"	MS-DOS and CP/M-86	56K	32,767	1024	fully addressable cursor
dBaseII	"	MS-DOS and CP/M-86	48K	65,535	1000	"
FMS-80	"	not available	56K	65,535	20K	"
Selector V	"	MS-DOS and CP/M-86	56K	65,535	25,245	"

APPENDIX B
Available Systems For ROKN

Manufacturer	Model	Ram	Pricing($)	Type of Processors
Action Computer Enterprise,Inc.	Discovery Multi-Processor Series	192K-1.6M	2740-30,000	Z80/8086
Centry Computer Corp.	Vanquard 8000-Micro	128K-1M	6000,8000	8085/8086
Columbia Data Products, Inc.	Columbia MPC	128K-1M	3395,4995	z80/8088
Cromemco, Inc.	System one D-Series	256K-4M	4995,11,285	z80/mc68000
FUJITSU Micro-electronics, Inc.	Micro 16s Personal Business	128K-1M	3995	z80/8086
NCR Corp.	Decision Mate V	64K-512K	2800-3340	z80/8088
NEC Home Electronics, Inc.	pc-8800	64K-512K	2497	z80/8086
North Star Computers,Inc.	Advantage 8/16	64K-256K	3399-6399	z80/8088-2
Vector Graphic, Inc.	Vector 4 Series	128K-256K	4495-6680	z80/8088
Zenith Data Systems	z-100 Series	192K-768K	2899-3599	8085/8088

APPENDIX C:
The Information on Dual Process Manufacturers

Mfr.	Est.	Empl.	Sales(mil)	First Dual Processor Shipment
Action Computer Enterprise,Inc.	1979	15	1	Jan, 1980
Century Computer Corp.	1979	36	1.5	1982
Columbia data products, Inc.	1975	147	10	1982
Cromenco,Inc.	1975	400	52	Oct,1981
Fujitsu Micro-electronics,Inc.	1935	40,000	3253	Summer,1983
NCR Corp.	1884	65,000	3526	May,1983
NEC Home Electronics	1981	85	Not Available	April,1983
North Star Computers,Inc.	1976	350	41	1981
Vector Graphic, Inc.	1976	300	36	1982
Zenith Data Data Systems	1979	740	100	1982

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